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ABSTRACT

Life Science AB is designed for students who do not plan to go to college. The course utilizes an investigative approach and emphasizes student involvement in the study of living organisms. This document contains the course outline and provides guidance to teachers in implementing the objectives and lessons of the course. Contents include: (1) summary of representative objectives; (2) time schedule and sequences of units; (3) teacher responsibilities; (4) guidelines for assigning homework; (5) units of study (containing the objectives, content outlines, and continuum skills for seven units); (6) teacher-directed lessons (providing three detailed samples); (7) listing of teaching strategies; (8) evaluation procedures; and (9) tips for parents. Appendices contain a listing of resources and the secondary science continuum for the Los Angeles Unified School District. (ML)

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# LIFE SCIENCE AB

## AN INSTRUCTIONAL COURSE OUTLINE

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# FOREWORD

Life Science AB is designed for students who do not plan to go to college; it fulfills the laboratory science requirement for graduation. The course provides students with opportunities for a comprehensive study of living organisms, utilizing an investigative approach. Through direct involvement in science processes and familiarity with important concepts, the student develops an awareness of relationships between organisms and gains important knowledge concerning their structure, function, behavior, and relationship with the environment.

Science is the discipline through which people acquire and organize knowledge to explain natural phenomena. Through the science instructional program in secondary schools, students develop an understanding that science is a body of knowledge comprised of interconnected sets of principles, laws, and theories that explain the known universe and our relationship to it. Students investigate phenomena systematically and acquire and refine information.

The emphasis of this course is on providing students with the knowledge and skills necessary for leading successful and productive lives in a technological society. This course also provides students with a variety of science-related educational choices to assist them in making future career plans and preparations.

For the subject of science to be a dynamic factor in the lives of students, instruction must be both relevant and appropriate to the developmental level of the pupils. This publication provides laboratory investigations and other activities to motivate individual development of critical thinking, decision making, and problem solving. Outcomes include understanding how humans use scientific information and discoveries essential for analyzing and comprehending one's environment and for developing approaches to the problems of daily living.

This Life Science Instructional Course Outline should be used in conjunction with the Secondary Science Skills Continuum and the Guidelines for Instruction, Science, (Publication No. SC-769.19, 1979). This publication will assist teachers in planning and implementing daily and weekly lessons and units of instruction, as well as in the achievement of course objectives.

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ACKNOWLEDGMENTS

Many persons contributed to the development of this instructional outline. Gratitude is expressed to those individuals who reviewed the content, suggested changes in the course descriptions and objectives, and recommended unit titles and concepts.

The Office of Instruction is especially indebted to JOEL COLBERT, who organized the suggestions of teachers and advisers and wrote the instructional course outline, incorporating ideas and lessons drawn from classroom experiences.

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## SUMMARY OF REPRESENTATIVE OBJECTIVES

| UNIT TITLE | OBJECTIVES |
|---|---|
| Unit One | |
| WHAT IS LIFE? | - Define characteristics of living organisms.<br>- Define evolution as change over time.<br>- Describe a theory concerning how life began.<br>- Compare modern theories of evolution.<br>- Describe how fossils are formed and cite examples.<br>- Identify and describe science-related careers. |
| Unit Two | |
| THE CELL: UNIT OF LIFE | - Identify the cell as the unit of structure of all living things.<br>- Compare and contrast animal cells from plant cells.<br>- Distinguish between different types of cells.<br>- Identify and describe science-related careers. |

| UNIT TITLE | OBJECTIVES |
| --- | --- |
| Unit Three<br>HEREDITY | - Compare and contrast dominant and recessive traits.<br>- Recognize the gene as the unit of inheritance.<br>- Use a Punnett Square to solve monohybrid genetics problems.<br>- Describe sexual and asexual reproduction, citing examples of each.<br>- Identify and describe science-related careers. |
| Unit Four<br>MONERANS, PROTISTS, AND FUNGI | - Describe the characteristics of protists and list the major groups.<br>- Assess the ways in which the protists and monerans affect other living organisms.<br>- Distinguish between organisms classified as protista and those classified as monera.<br>- Describe the structure and function of fungi. |
| Unit Five<br>PLANT STRUCTURE AND FUNCTION | - Describe the steps in photosynthesis.<br>- Discuss the importance of the seed and flower.<br>- Maintain plants for ornamental and laboratory use.<br>- Identify and describe science-related careers. |

| UNIT TITLE | OBJECTIVES |
| --- | --- |
| Unit Six | |
| ANIMAL STRUCTURE AND FUNCTION | - Describe the major organ systems of animals.<br>- Describe the steps in respiration.<br>- Demonstrate the use of a classification system, based on observable characteristics.<br>- Maintain animals for safe laboratory use.<br>- Identify and describe science-related careers. |
| Unit Seven | |
| ECOLOGY AND CONSERVATION | - Recognize the dependence of all living things upon the abiotic environment.<br>- Give examples of feeding relationships in a community.<br>- Assess the effects of various types of pollution on the environment and its inhabitants.<br>- Identify and describe science-related careers. |

TIME SCHEDULE AND SEQUENCE OF UNITS
FOR LIFE SCIENCE AB

The scope of instructional content for the course is organized into seven broad units of instruction dealing with the nature of life, cells, heredity, protists, plants, animals, and environmental concerns. In reviewing the list of content topics, it may be noted that the initial focus should be upon students first relating to their immediate environment and experiences and then moving to interrelationships with society and more theoretical concepts. The unit sequences may be altered to meet the needs and interests of students.

| UNIT | TOPICS | WEEKS |
|---|---|---|
| ONE | WHAT IS LIFE? | 5 |
| TWO | THE CELL: UNIT OF LIFE | 5 |
| THREE | HEREDITY | 5 |
| FOUR | MONERA, PROTISTA, AND FUNGI | 5 |
| FIVE | PLANT STRUCTURE AND FUNCTION | 5 |
| SIX | ANIMAL STRUCTURE AND FUNCTION | 6 |
| SEVEN | ECOLOGY AND CONSERVATION | 5 |

## TEACHER RESPONSIBILITIES

Teachers are responsible for creating, maintaining, and fostering a classroom environment and climate for learning which provides for instructional excellence and achievement. In order to successfully maintain such an environment, teachers are responsible for:

1. Providing students and parents with a clear statement of instructional objectives, overall goals, and standards of expected progress and achievement.

2. Providing instruction which incorporates a diagnostic-prescriptive program for learning all required skills and concepts.

3. Following the timeline as closely as possible, preparing instructional activities for the entire class period, and striving for mastery of content and process skills.

4. Having evidence in the classroom of lesson planning to meet the educational needs of the students and the goals of the instructional program.

5. Providing regular instruction and practice in preparing students to take and succeed on tests and other measures of achievement.

6. Providing well-defined and consistently maintained classroom standards for academic achievement, citizenship, and work habits.

7. Providing regularly assigned student homework designed to reinforce classroom instruction.

8. Providing students and parents with an explanation of the standards used for assigning marks.

9. Providing prompt feedback to students on quizzes, homework, and other class assignments.

10. Recognizing individual student progress and exceptional achievements and displaying student accomplishments and products in the classroom.

11. Recording a minimum of one grade per week in the rollbook for each student.

12. Keeping parents regularly informed of the educational progress and achievement of the student.

13. Informing parents of outstanding progress and accomplishment.

14. Notifying parents of any signs of significant academic decline in student effort or achievement.

15. Providing parents with suggestions on how to help the student study and complete homework assignments.

16. Inviting administrators, department chairpersons, and fellow teachers to visit their classrooms and participate in a sharing of effective and innovative lessons.

## GUIDELINES FOR ASSIGNMENT OF HOMEWORK

The guidelines that follow should be considered when planning homework assignments:

1. Homework is an important resource for teachers in helping students to learn.

2. Homework may be scheduled when appropriate over an extended period of time which may include weekends.

3. Homework assignments should be reasonable in length, content, and required resources.

4. Homework should be assigned to reinforce, extend, and enrich areas which have been taught.

5. Homework assignments should be related to subject objectives.

6. Homework assignments and due dates should be thoroughly explained by the teacher and understood by the student.

7. Homework once appropriately assigned by the teacher becomes the responsibility of the student to know the content, process and due date, and to complete and return as required.

8. Completed homework assignments should be acknowledged and/or evaluated by the teacher and reviewed with students when appropriate.

Parents/guardians should be informed of homework schedules, including dates given and time allowance. They should also understand the level of independent work expected of the student and the parental help and involvement required.

# UNIT ONE: WHAT IS LIFE?

5 WEEKS

## Representative Objectives for This Unit

- Define characteristics of living organisms.
- Define evolution as change over time.
- Describe a theory concerning how life began.
- Compare modern theories of evolution.
- Describe how fossils are formed and cite examples.
- Identify and describe science-related careers.

## Content

I. In order to gain appreciation for living things, it is essential to understand what life is and how it began.

   A. A living organism is one that moves, grows, reproduces, metabolizes, and dies.
   B. Theories of how life began

      1. Big Bang Theory
      2. Abiogenesis
      3. Biogenesis

II. Modern theories of evolution provide evidence for the development of species.

   A. LaMarck's Theory of Evolution
   B. Darwin's Theory of Natural Selection
   C. Physical Anthropology

      1. Fossil Evidence
      2. Human Evolution

## Continuum Skills

1.1.0 Shows curiosity about objects and events.

1.3.0 Appreciates and respects all living organisms, including self and his/her relationship to the environment.

1.5.2 Examines a variety of alternative viewpoints on scientific issues to form opinions about them.

1.7.0 Has a critical, questioning attitude toward inferences, hypotheses, and theories.

3.5.0 Records observations accurately and organizes data and ideas in ways that improve their usefulness.

3.6.2 Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.

3.7.0 Uses the metric system effectively.

4.5.1 Matches significant discoveries to person's responsible.

4.6.1 Identifies how modern techniques of determining the age of specimens contribute to knowledge of earlier civilizations.

| Content | Continuum Skills |
| --- | --- |
| | 4.8.2 Recognizes that all living organisms have the same life processes. |
| | 4.8.9 Recognizes that a living organism is a product of its heredity and environment. |
| | 4.8.12 Recognizes that living organisms have changed over the ages and that some species are now extinct. |
| III. Careers | 4.4.0 Demonstrates knowledge of science-related opportunities and the preparation needed. |
| A. Research assistants<br>B. Field assistants<br>C. Museum and zoo workers | |

## UNIT TWO: THE CELL: UNIT OF LIFE

5 WEEKS

### Representative Objectives for This Unit

- Identify the cell as the unit of structure of all living things.
- Compare and contrast animal cells from plant cells.
- Distinguish between different types of cells.
- Identify and describe science-related careers.

### Content

I. The cell is the unit of structure for all living organisms.

A. Cell boundary

1. Cell wall
2. Plasma membrane

B. Cytoplasm

Organelles

C. Nucleus

1. DNA
2. RNA
3. Control mechanism

D. Recent developments

1. Recombinant DNA
2. Cloning
3. Cancer

### Continuum Skills

2.1.1 Examines objects carefully, using a combination of senses to collect and process data; derives meaning from the observation; recognizes the need to use simple instruments to aid the senses in collecting data.

2.4.0 Participates in scientific inquiry at the appropriate level.

3.1.0 Assembles and uses laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.

3.3.1 Makes purposeful, objective observations.

3.6.2 Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.

4.1.0 Demonstrates knowledge of the process of scientific inquiry.

4.8.1 Recognizes that a cell is the basic unit of structure and function of a living organism.

4.8.2 Recognizes that all living organisms have the same life processes.

| Content | Continuum Skills |
| --- | --- |
| II. The cell is the unit of function for all living organisms. | 4.8.11 Understands relationships of structure and function of living organisms to their environment. |
| A. Movement | |
| 1. Diffusion | |
| 2. Active transport | |
| B. Energy production | |
| 1. Photosynthesis | |
| 2. Respiration | |
| 3. Fermentation | |
| C. Control | |
| 1. DNA replication | |
| 2. Protein synthesis | |
| III. Cell Types | |
| A. Plant Cells | |
| B. Animal Cells | |
| C. Protist Cells | |
| D. Monerans (may not have true cells) | |
| IV. Careers | 4.4.0 Demonstrates knowledge of science-related career opportunities and the preparation needed. |
| A. Laboratory Technician | |
| B. Histologist | 4.4.2 Identifies ways in which careers are science related. |
| C. Electron microscope technician | |
| D. Related-technical careers | |

## UNIT THREE: HEREDITY

5 WEEKS

### Representative Objectives for This Unit

- Compare and contrast dominant and recessive traits.
- Recognize the gene as the unit of inheritance.
- Use a Punnett Square to solve monohybrid genetics problems.
- Describe sexual and asexual reproduction, citing examples of each.
- Identify and describe science-related careers.

### Content

I. The gene is the unit of inheritance.

- A. Chromosomes
- B. DNA
- C. RNA

II. Gregor Mendel laid the foundation for genetic principles.

- A. Law of Dominance
- B. Law of Segregation
- C. Law of Independent Assortment
- D. Mendel's pea experiments

III. Mutations

- A. Causes
  1. Heat
  2. Radiation
  3. Chemical
  4. Spontaneous
- B. Effects

### Continuum Skills

1.8.2 Applies science problem-solving techniques in everyday life situations.

1.9.3 Values the scientific contributions of human beings from varying cultural backgrounds.

3.4.0 Gathers needed information which has been generated by others from a variety of sources appropriate to his/her ability level.

3.4.2 Gathers information from science textbooks, reference materials, science films, and television.

3.6.2 Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.

4.8.4 Understands and describes living organisms that grow and develop in different environments.

4.8.9 Recognizes that a living organism is a product of its heredity and environment.

4.8.10 Recognizes that all forms of life are composed of the same elements in different DNA "blueprints."

| Content | Continuum Skills |
| --- | --- |
| C. Genetic Disorders of Animals<br>1. Changes in genes<br>2. Extra chromosomes<br>3. Missing parts of chromosomes<br>4. Sex-linked disorders | 4.8.11 Understands relationships of structure and function of living organisms to their environment.<br>4.8.12 Recognizes that living organisms have changed over the ages and that some species are now extinct. |
| IV. Reproduction assures the survival of the species.<br>A. Asexual Reproduction<br>1. Involves 1 parent<br>2. Types<br>a. Fission<br>b. Vegetative<br>c. Sporulation<br>d. Regeneration<br>e. Examples of each type<br>B. Sexual Reproduction<br>1. Involves 2 parents<br>2. Few offspring | |
| V. Careers<br>A. Laboratory technician<br>B. Cytohistologist<br>C. Related health careers<br>1. Medical assistant<br>2. Nursing | 4.4.0 Demonstrates knowledge of science-related career opportunities and the preparation needed.<br>4.4.2 Identifies ways in which careers are science related. |

## UNIT FOUR: MONERA, PROTISTA, AND FUNGI

5 WEEKS

### Representative Objectives for This Unit

- Describe the characteristics of protists and list the major groups.
- Assess the ways in which the protists and monerans affect other living organisms.
- Distinguish between organisms classified as protista and those classified as monera.
- Describe the structure and function of fungi.

### Content

I. Monerans are microscopic, one-celled procaryotes.

   A. Examples

      1. Bluegreen algae
      2. Bacteria

   B. Reproduction
   C. Symbiosis

      1. Mutualism
      2. Parasitism
      3. Beneficial and harmful effects on animals and plants.

II. Protists are microscopic, one-celled eucaryotes.

   A. Examples

      1. Amoeba
      2. Paramecium
      3. Euglena

### Continuum Skills

1.3.1 Accepts responsibility for the care of living organisms in natural and artificial environments.

2.2.1 Perceives similarities and differences in a set of objects; separates a set into groups, according to a single characteristic.

3.1.0 Assembles and uses laboratory apparatus, tools, and materials in a skillful manner, giving attention to safety measures.

4.2.12 Recognizes that classification systems are developed by humans for the use of humans and are one way of helping to understand the basic organization and pattern of nature.

4.8.0 Demonstrates general knowledge of science.

4.8.1 Recognizes that a cell is the basic unit of structure and function of a living organism.

4.8.11 Understands relationships of structure and function of living organisms to their environment.

| Content | Continuum Skills |
| --- | --- |
| B. Reproduction<br>C. Parasitic effects on humans and animals | |
| III. Fungi are multicellular eucaryotes. | |
| A. Lack of chlorophyll; saprophytic or parasitic.<br>B. Examples | |
| 1. Mushrooms<br>2. Molds | |
| C. Reproduction<br>D. Beneficial and parasitic effects | |
| IV. Careers | 4.4.0 Demonstrates knowledge of science-related career opportunities and the preparation needed. |
| A. Laboratory technician<br>B. Pathology lab technician<br>C. Health-related careers | 4.4.2 Identifies ways in which careers are science related. |
| 1. Medical assistant<br>2. Dental assistant<br>3. X-ray technician<br>4. Nurse<br>5. Nurses' aide | |

## UNIT FIVE: PLANT STRUCTURE AND FUNCTION — 5 WEEKS

### Representative Objectives for This Unit

- Describe the steps in photosynthesis.
- Discuss the importance of the seed and flower.
- Maintain plants for ornamental and laboratory use.
- Identify and describe science-related careers.

### Content

I. Plants are nonmotile organisms.

A. Taxonomy

1. Algae
2. Vascular and non-vascular plants
3. Seed-bearing plants
4. Flowering plants

B. Structure

1. Root
2. Stem
3. Leaf
4. Flower
5. Seeds and fruits

II. Plants utilize solar energy and convert into usable chemical energy.

A. Photosynthesis
B. Tropisms

### Continuum Skills

1.1.1 Shows willingness to examine and organize objects and events in the environment.

1.3.0 Appreciates and respects all living organisms, including self and his/her relationship to the environment.

2.1.1 Examines objects carefully, using a combination of senses to collect and process data; derives meaning from the observation; recognizes the need to use simple instruments to aid the senses in collecting data.

2.2.0 Develops ability to organize data by comparing, classifying, relating, and/or deriving.

3.1.0 Assembles and uses laboratory apparatus, tools, and materials in a skillful manner, giving due attention to safety measures.

3.2.0 Demonstrates proper techniques for handling and caring for living organisms.

3.2.2 Provides an environment for plant and animal life that is conducive to the support of normal function.

| Content | Continuum Skills |
| --- | --- |
| III. Plants need maintenance. | |
| A. Amount of light necessary | 3.6.2 Explains either orally or in writing the methods and procedures involved in carrying out an investigation. |
| B. Watering | |
| C. Food supplement | 4.3.3 Identifies types of data valuable in planning environmental changes. |
| | 4.8.5 Recognizes that the sun is the source of energy for green plants and is basic to the growth and maintenance of living organisms. |
| | 4.8.6 Recognizes the importance of energy levels as related to ecosystems. |
| | 4.8.8 Describes examples of humankind's dependence on and interference with natural ecosystems. |
| | 4.8.11 Understands relationship of structure and function of living organisms to their environment. |
| IV. Careers | 4.4.0 Demonstrates knowledge of science-related career opportunities and the preparation needed. |
| A. Horticulture | |
| B. Propagation | |
| C. Nursery maintenance | |
| D. Plant laboratory technician | |

## UNIT SIX: ANIMAL STRUCTURE AND FUNCTION

6 WEEKS

### Representative Objectives For This Unit

- Describe the major organ systems of animals.
- Describe the steps in respiration.
- Demonstrate the use of a classification system, based on observable characteristics.
- Maintain animals for safe laboratory use.
- Identify and describe science-related careers.

### Content

I. Animals are heterotrophic, motile organisms of great diversity.

A. Taxonomy

1. Invertebrate

a. Porifera
b. Coelenterata
c. Worms
d. Mollusks
e. Arthropods

2. Vertebrate

a. Chrodates
b. Vertebrates

1. Fish
2. Amphibians
3. Reptiles
4. Birds
5. Mammals

### Continuum Skills

1.3.0 Appreciates and respects all living organisms, including self and his/her relationship to the environment.

1.3.1 Accepts responsibility for the care of living organisms in natural and artificial environments.

1.10.1 Considers science-related careers and makes realistic decisions about preparing for such careers, taking into account abilities, interests, and preparation required.

2.2.2 Develops arbitrary classification systems wherein objects can be put into mutually exclusive categories; uses quantitative measurements as criteria for grouping.

2.4.0 Participates in scientific inquiry at the appropriate level.

3.1.0 Assembles and uses laboratory apparatus, tools and materials in a skillful manner, giving due attention to safety measures.

3.2.1 Handles plants and animals carefully, following suggested procedures.

3.6.0 Communicates with others in a manner that is consistent with knowledge.

| Content | Continuum Skills |
| --- | --- |
| II. Animals have general structural characteristics. | |
| A. Organ/system level or organization | |
| B. Interaction of systems for maintenance of the whole organism | |
| III. Physiologists deal with animal functions and life processes. | |
| A. Respiration | |
| B. Metabolism | |
| 1. Balanced diet | |
| 2. Effects of pollution | |
| C. Behavior | |
| IV. Animals live in a variety of habitats. | |
| A. Life in a pond | |
| B. Life on land | |
| C. Life in the air | |
| D. Life in the ocean | |
| E. Life in trees | |
| F. Life underground | |
| V. Animals need care and maintenance. | |
| A. Environmental requirements | |
| B. Nutritional requirements | |
| C. Behavioral needs | |
| D. Health care for animals | |
| 1. Veterinarian assistant | |
| 2. Animal technician | |
| 3. Zoo keeper | |
| 4. Aquarium maintenance | |
| 5. Museum assistant | |
| 6. Nutritionist | |
| 7. Nursing and nurses'aide | |
| | 4.3.3 Identifies types of data valuable in planning environmental change. |
| | 4.7.1 Given a list of foods, identifies items that would constitute a nutritious, balanced diet. |
| | 4.8.2 Recognizes that all living organisms have the same life processes. |
| | 4.8.4 Understands and describes living organisms that grow and develop in different environments. |
| | 4.8.9 Recognizes that a living organism is a product of its heredity and environment. |
| | 4.8.11 Understands relationships of structure and function of living organisms to their environment. |
| | 4.8.12 Recognizes that living organisms have changed over the ages and that some species are now extinct. |
| | 4.4.0 Demonstrates knowledge of science-related career opportunities and the preparation required. |

## UNIT SEVEN: ECOLOGY AND CONSERVATION

5 WEEKS

### Representative Objectives For This Unit

- Recognize the dependence of all living things upon the abiotic environment.
- Give examples of feeding relationships in a community.
- Assess the effects of various types of pollution on the environment and its inhabitants.
- Identify and describe science-related careers.

| Content | Continuum Skills |
|---|---|
| I. The layer where life exists is the biosphere. | 1.2.0 Recognizes and reports evidence of order and symmetry in the environment. |
| A. Biosphere<br>B. Ecosystem | 1.3.0 Appreciates and respects all living organisms, including self and his/her relationship to the environment. |
| 1. Living factors<br>2. Nonliving factors | 1.3.2 Appreciates the interdependence of living organisms in the natural environment and the implications for continued survivial. |
| C. Physical Cycles | |
| 1. Water cycle<br>2. Carbon-Oxygen cycle<br>3. Nitrogen cycle | |
| II. The earth consists of 11 biomes. | 1.4.0 Takes an active role in solving social problems related to science and technology. |
| A. Polar regions<br>B. Tundra<br>C. Coniferous forests<br>D. Deciduous forests<br>E. Tropical rain forests<br>F. Grasslands<br>G. Deserts | 1.10.1 Values the ability, interests, and preparation required for a science-related career. |
| | 2.3.0 Develops ability to apply and evaluate data and generate theories by hypothesizing, predicting, inferring, generalizing, theorizing, explaining, justifying, judging, and interpreting. |

Content

H. Marine
I. Taiga
J. Fresh water
K. Scrub forests

III. Biotic factors in the environment are important.

A. Food chains

1. Producers
2. Consumers
3. Decomposers

B. Energy pyramids

1. Entropy
2. Biomass

IV. Humans pollute the environment.

A. Types of pollution

1. Noise
2. Water
3. Air
4. Overpopulation

B. Effects of pollution

1. Environmental effects
2. Effects on humans
3. Effects on other organisms

a. Endangered species
b. Decreased natural resources

C. Economic exploitation

1. Endangered species
2. Resources

Continuum Skills

3.4.2 Gathers information from science textbooks, reference materials, science fiction, and television.

3.6.2 Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation.

4.1.2 Matches names of various processes and products of scientific inquiry with examples.

4.2.1 Identifies simple cause-effect relationships.

4.3.3 Identifies types of data valuable in planning environmental changes.

4.8.4 Understands and describes living organisms that grow and develop in different environments.

4.8.7 Recognizes that living organisms utilize matter and return it to the environment.

4.8.11 Understands relationships of structure and function of living organisms to their environment.

| Content | Continuum Skills |
| --- | --- |
| V. Conservation | |
| A. Natural resources | |
| 1. Forests | |
| 2. Water | |
| 3. Soil | |
| B. Energy | |
| 1. Fossil fuels | |
| 2. Alternative energy sources | |
| a. Solar | |
| b. Geothermal | |
| c. Nuclear | |
| d. Wind | |
| VI. Science-related careers | 4.4.0 Demonstrates knowledge of science-related career opportunities and the preparation needed. |
| A. Forest personnel | |
| B. Landscaping specialist | |
| C. Laboratory technician | |
| 1. Sewage treatment | |
| 2. Water treatment | |
| 3. Solid waste management | |
| D. Zoo maintenance | |

## SAMPLE TEACHER-DIRECTED LESSONS

Successful teaching begins with careful planning. Three sample lessons are shown on pages 17 to 23.

The lesson plans follow the format of the seven-point teacher-directed lesson. The questions below need to be addressed when an instructor is designing a teacher-directed lesson:

- What is the specific objective and how will it be presented to the students?
- What is the value in achieving the objective?
- What learning activities must be modeled, explained, or illustrated for students?
- What guided group practice will be provided for the students?
- What independent practice or activity will be provided for the students?
- What provisions will be made for individual differences in learning styles?
- How will the lesson be evaluated?

SAMPLE LESSON - I

Course: Life Science AB

Representative Objective: Students will be able to examine objects carefully, using a combination of senses to collect and process data.

Skills Emphasized: Speaking, Writing, Reading, and Listening

Thinking/Cognitive Skills: Analysis

1. Specific Objective

Students will be able to identify and compare specific adaptations in living and prepared specimens of plants and animals.

2. Value to Students

Students develop observational skills and compare survival adaptations in various organisms. The skills developed and interaction between students are valuable for increasing cooperation and social skills.

3. Initial Instruction/Teacher Presentation

The teacher introduces the concept of adaptation either by lecture/discussion and/or use of audiovisual aids, e.g., filmstrip or movie. Materials selected could show specific adaptations for eating, temperature, and locomotion. Teacher instructs students to move from station to station around the room, answering the analysis questions at the appropriate stations. (see Guided Group Practice.)

Materials

Various living and preserved specimens on display at stations throughout the laboratory.

Station 1. Fish, frog, mouse, grasshopper, beetle, millipede, centipede, crayfish, tadpole
Station 2. Tree frog, bullfrog, preserved mole
Station 3. Dragonfly nymph, flea, grasshopper, butterfly, giant water bug
Station 4. Prepared slide of cross section of Elodea leaf
Station 5. Potted cactus plant
Station 6. Prepared slide of a tapeworm
Station 7. Venus fly trap plant and pea plant
Station 8. Frog, toad, newt, or salamander

Station 9. Skulls of cat, rabbit, opossum
Station 10. Prepared slides of ulothrix and spirogyra
Station 11. Milkweek pod, dandelion "head," Spanish needle, maple seed, grape with seeds
Station 12. Potato tubes, iris rhizome (cut in half)

4. Guided Group Practice

Students are divided into teams of two and move from station to station, making careful observations and answering the analysis questions. The teacher monitors progress by observing students as they work.

Analysis Questions

Station 1

1. List the organs of locomotion for each specimen.
2. Describe how each organ is adapted for movement.
3. Describe similarities and differences.
4. Explain how each is adapted for a specific environment.

Station 2

1. How are the feet of each organism adaptive?
2. What, if any, are the differences between front and rear feet for each organism?

Station 3

Which insects have mouth parts adapted for biting? For sucking and piercing? For catching and holding prey?

Station 4

1. How is the leaf adapted for photosynthesis?
2. How is the leaf adapted to float on water?

Station 5

1. How are the leaves adapted for living in a dry environment?
2. How is the stem adapted for water storage?

Station 6

How is the tapeworm's shape an adaptation for life in the human intestine?

Station 7

1. How is the color of the inside of a Venus fly trap's leaf adapted for catching insects?
2. What other adaptations does the Venus fly trap have for catching insects?
3. What is the function of the specialized leaves (tendrils) of the pea plant?

Station 8

How is the skin of each animal an adaptation to its environment?

Station 9

How does the tooth pattern, in each skull show how it helped the animal survive in its environment?

Station 10

1. Which algae are adapted to fast-moving water?
2. Which algae are adapted to slow-moving or still water?
3. How do the structures in the two types of algae help each live in fast or slow water?

Station 11

How are the seeds adapted for dispersal over a wide area?

Station 12

How is each underground stem adapted for food storage and reproduction?

5. Independent Practice

Students are given a homework assignment to identify at least five organisms living near their homes and to describe any specialized adaptive features.

6. Individual Differences and Learning Modalities

Remediation/alternative activities: Additional practice can be provided to students who do not grasp the concept by having them work with students who do.

Enriched/supplemental activities: Ask those students who finish early to write an essay on the specialized adaptive features that enable humans to live in any environment.

7. Evaluation

Responses to analysis questions and essays are to be marked. Observations are also a valuable assessment tool.

SAMPLE LESSON - II

Course: Life Science AB

Representative Objective: Students will be able to demonstrate the use of a classification system based on observable characteristics.

Skills Emphasized: Speaking, Writing, Reading, and Listening

Thinking/cognitive Skills: Application

1. Specific Objective

   Students will be able to classify animals into the correct phylum and class, using a taxonomic key.

2. Value to Students

   Students develop observation and organizational skills that are useful in real-life situations, such as when buying automobiles or shopping for groceries.

3. Initial Instruction/Teacher Presentation

   Students are shown various species of animals and asked how specific structures and functions are alike and different. These could include numbers of legs, body covering, fluctuations in temperature and method of bearing young. The concept of taxonomy is introduced, and students receive a simple key (see Guided Group Practice.) The teacher explains how a taxonomic key is used.

4. Guided Group Practice

   Ten to fifteen stations are set up around the room. One animal species is placed on display at each station. Students work with a partner and classify the specimens into the correct phylum and class, using the key. The instructor monitors students progress by observing the numbers of each team as the students classify the specimens.

   Directions to students:

   Starting with number one, read each couplet (1a & 1b, 2a & 2b), and decide which one fits the organism you are looking at. After you have chosen the proper phrase, follow that line to the right and go to the couplet that is given. Again, read both lines of the couplet, and make your choice. Go to the next couplet indicated by the number. Repeat this procedure until you come to the phylum name instead of the number. Write the phylum name and the class, if given, on your paper next to the common name.

1a. Worm-like body. . . . . 2
1b. Any other body. . . . . 4

2a. If worm is cut in half, shape of cross section of body is round. . . . . .3
2b. If worm is cut in half, cross section is flat. . . . . .Platyhelminthes

3a. Round worm, body smooth . . . . . Aschelminthes
3b. Round worm, body segmented (divided into rings) . . . . . .Annelida

4a. Body symmetry radial . . . . . .5
4b. Body symmetry any other way. . . . . .6

5a. Tentacles present, body soft. . . . . . Coelenterata
5b. Tentacles absent, body hard and rough . . . . . Echinodermata

6a. Exoskeleton or shell present. . . . . 7
6b. Exoskeleton or shell absent. . . . . .8

7a. Jointed legs present. . . . . .Arthropoda
7b. Jointed legs absent. . . . . .Molusca

8a. Hair present. . . . . Chordata-Mammalia
8b. Hair absent. . . . . .9

9a. Feathers present. . . . . Chordata-Aves
9b. Feathers absent. . . . . 10

10a. Paired fins present. . . . . Chordata-Pisces
10b. Paired fins absent. . . . . .11

11a. Skin scales present. . . . . .Chordata-Reptilia
11b. Skin scales absent. . . . . Chordata-Amphibia

5. Independent Practice
In class students are instructed to develop a classification scheme and data table in order to classify. Using their taxonomic key, classify at least three animals living outside of school and/or at home.

6. Individual Differences and Learning Modalities
Remediation/alternative activities: Students who work rapidly help students who work slowly. Students can be divided initially into heterogeneous teams.
Enrichment/supplemental activities: Specimens of extra, more difficult species are available for classifying by those students who complete the assignment quickly.

7. Evaluation
Student answer sheets on which organisms have been taxonomically keyed are to be marked.

SAMPLE LESSON - III

Course: Life Science AB

Representative Objective: Recognize the normal condition of the human organism and develop an appreciation of homeostasis.

Skills Emphasized: Speaking, Writing, Reading, and Listening

Thinking/Cognitive Skills: Comprehension

1. Specific Objective

   Students will be able to identify dominant and recessive traits in humans to improve understanding of the normal condition.

2. Value to Students

   Students gain an understanding of their human characteristics. By studying heredity, they gain an appreciation for the uniqueness of humans and also recognize that genetic disorders are inherited.

3. Initial Instruction/Teacher Presentation

   The teacher introduces the concept of heredity, dominance, and recessiveness either by lecture/discussion and/or through use of audiovisual resources. Materials selected could be a single developmental chart or overhead transparencies using flower or human eye color as an example. He/she identifies some dominant and recessive traits in students and asks students to identify others.

   Materials

   PTC paper
   mirror
   hand lens
   pencil and paper

4. Guided Group Practice

   Students work with a partner and follow the procedures below. After they have made and recorded their observations, the teacher utilizes the follow-up questions to initiate class discussion.

Procedures

1. Taste PTC paper. If you can taste it, you are a "taster." Use a capital T to indicate the dominant gene for being a taster and a small t to indicate the recessive, "nontaster" gene. Record which gene is present.

2. With the help of a partner or mirror, see if your ear lobes are free (F) to your head.

3. Note that widow's peak (W) is a special kind of hairline. The hair seems to come to a point in the center of the hairline. Widow's peak (W), is dominant over a continuous hairline (w). Record which gene you have.

4. Note that the ability to roll up the sides of the tongue (T) is dominant over the inability to roll up the sides of the tongue (t). Record the gene that you have.

Follow-Up Questions

What are some dominant traits that you have inherited?
What percentage of your class has each dominant trait?
What are some recessive traits that you have inherited?

5. Independent Practice

Students are to make a list of family members and develop a worksheet to identify the patterns of inheritance within their own families.

6. Individual Differences and Learning Modalities

Remediation/alternative activities: Students who do not grasp the concepts can be given an additional reading assignment explaining heredity. Worksheets can be provided with follow-up questions on the reading.

Enrichment/supplemental activities: Students can construct a family tree, selecting one or more of the traits used in this investigation.

7. Evaluation

Students participate in discussion based upon responses to the follow-up questions and/or write an essay explaining the concept of dominance and recessiveness.

## TEACHING STRATEGIES

A variety of instructional strategies can enhance the students' growth in concept and skill development. Examples of these instructional strategies include:

- Teacher-directed lesson with the class investigating the same problem.
- Teacher demonstration with the class observing and recording observations and data.
- Independent study. Students conduct independent research and study concept or process areas. When completed, such individual work provides a basis for class learning projects.
- Team learning situations wherein two to four students function together as a laboratory investigation group. Interaction within and among groups acts both as a stimulus and an information-sharing aid to learning.
- Grouping of lower achieving students with those achieving at a higher level. This permits peer tutoring and interaction which can benefit the less motivated individuals.
- Contract between student and teacher which outlines and prescribes specific tasks to be performed by the student for the fulfillment of certain course requirements.
- Self-paced learning designed for mastery. Assessment is conducted as each student concludes each unit, and the results indicate whether a student is ready to advance to the next unit or experience--a repeated opportunity for the instructor to use a new strategy. Student's mark is based on number of units mastered.
- Library research studies wherein many of the principles learned in laboratory and class activities can be applied to a class, small group (team), or individual project.
- Class presentations by individual or laboratory teams on the outcomes of laboratory investigations which are shared with the class.
- Design and formulation of research projects. Individuals or teams apply the methods, material, and techniques learned to a real experimental investigation.

## EVALUATION PROCEDURES

The evaluation of instruction is an integral part of the educational process. It provides information on what has been accomplished and where to go next. The first phase of evaluation should be diagnostic. The teacher should assess what students know before instruction, and then plan an appropriate course of instruction based on students' knowledge and abilities. In addition to diagnostic pretesting, ongoing evaluation during instruction provides teachers with a record of student progress and indicates the instructional changes that may have to be made in order to plan for maximum achievement. Post-testing assesses how well students have met the objectives at the end of the unit or course. The Secondary Science Continuum provides teachers with a basis for the development of instructional objectives.

The selection or construction of appropriate instruments of evaluation is critical to the measurement process. Test items must measure and reflect instructional objectives. Tests of achievement and problem-solving skills often require advanced reading skills. Therefore, it is recommended that diagrams, graphs, and pictures also be used to evaluate student progress and achievement.

Various measures of evaluation can be used in all phases of science education. Achievement tests assess science knowledge and comprehension. Problem-solving measures are useful for measuring higher cognitive skills such as analysis, synthesis, and evaluation. Motor skills and skill in the application of scientific knowledge can be evaluated in the laboratory setting. Observation and interview techniques are useful in the assessment of such laboratory skills as manipulating of materials, setting up experiments, handling and caring for live specimens, and employing safety practices. These measurement techniques allow for immediate feedback to students.

Suggested assessment procedures include the following: teacher-prepared tests; commercially-prepared tests; departmental tests; informal and formal assessment of individual and group activities in oral work and discussion; and student-prepared test items which provide reinforcement and the opportunity to apply course content.

## TIPS FOR PARENTS

There are many ways in which parents can provide the proper guidance, motivation, assistance, and a nurturing home environment for their youngster's success and learning in science.

1. Show an active interest in your youngster's science learning activities. Take notice of and respond to science-related conversations, books, magazine and newspaper articles.

2. Be an observer. Offer assistance with a statement like, "We can discover by observation." This will stimulate and help your youngster to understand how knowledge develops through observation, thought, exploration, and verification.

3. Be a good listener, and discuss science interests and questions. This will help you learn more about your youngster's interests, thinking and reasoning abilities, and attitudes.

4. Read, review, and discuss homework and other class assignments.

5. Share experiences. For example, if you are an amateur gardener, mechanically inclined a rock and mineral collector, etc., then you have something to share and to contribute to your youngster's developing curiosity about scientific interests.

6. Learn together. Encourage questions. Help your youngster locate sources of information and plan activities that provide opportunities for observing, experimenting, and recording data and the results of experimentation.

7. Practice scientific skills and attitudes. For example, help your youngster learn to withhold judgments until sufficient evidence has been secured, to challenge sources of information, and to be open-minded. These efforts will lead students toward the attainment of productive scientific attitudes.

8. Provide a quiet work and study area which can be used for homework and study, developing collections, experimenting, and making things.

9. Provide materials for learning, such as science-related books and magazines. Not only do they help students answer questions, but they also provide opportunities to experience the satisfaction of independent discovery.

10. Plan visits to museums, science fairs, observatories, zoos, national parks, open houses at universities, industry and governmental agencies, and other places of scientific interest.

11. Discuss with the teacher your youngster's progress and the specific learning needs which can be met through home study, and how your youngster might receive individualized help if needed.

12. Consult with the teacher and librarian about the selection of science-related books, magazines, and other materials available for reading. Become familiar with some of the science apparatus, displays, books, audiovisual, and other instructional materials used by the school.

13. Learn about the school's science program. Parental support of the school program is an essential factor in shaping positive attitudes toward education.

APPENDIXES

RESOURCES

A Collection of Selected Goals and Objectives. Los Angeles Unified School District: Office of Instruction.

A Statement of Goals. Los Angeles Unified School District: Office of Instruction. Publication No. GC-31, 1975.

Administrative Directives and Curricular Information. Los Angeles Unified School District: Office of Instruction. Publication No. SC-769. Stock No. 461260.

Audiovisual Materials Resource List, Secondary Schools Edition. Latest Revision. Los Angeles Unified School District: Audiovisual Services Section.

Catalog of Standard Equipment for Elementary, Secondary and Adult Schools. Latest Revision. Los Angeles Unified School District: Materiel Section.

Evaluation Summary - Science Continuum Assessment, Version 1, 1979-1980; Version 2, 1981. Los Angeles Unified School District: Office of Instruction.

Catalog of Films for Secondary and Adult Levels. Latest Revision. Los Angeles Unified School District: Audiovisual Services Section.

Guidelines for Assignment of Homework for Elementary and Secondary Schools. Los Angeles Unified School District: Office of Instruction, Publication No. GC-67, 1978. 16 pp.

Guidelines for Instruction, Science, Secondary School Curriculum. Los Angeles Unified School District: Office of Instruction. Publication No. SC-769.19. 1979.

Instructions for Teachers on the Assessment of the Secondary Science Continuum, Grades 7-12, for Junior and Senior High Schools, 1980-81. Los Angeles Unified School District: Office of Instruction, Publication No. SC-795, 1980.

List of Authorized Textbooks, Junior and Senior High Schools and Community Adult Schools. Latest Revision. Los Angeles Unified School District: Textbook Services Section. Publication No. 426.

List of California State Series Textbooks and Prepared Instructional Materials. Latest Revision. Los Angeles Unified School District: Research and Evaluation Branch.

Marking Practices and Procedures for Elementary and Secondary Schools. An Instructional Bulletin. Los Angeles Unified School District: Office of Instruction. Publication No. GC-74, 1978. 62 pp.

Metrics (SI) for the Secondary Classroom. Los Angeles Unified School District: Office of Instruction. Publication No. SC-731. 1976. 186 pp.

ME=US. Based on 30 different subject-area module booklets designed to improve basic skills of learners in the areas of reading, mathematics, and general science concepts. Ordering information available from project director. (213) 660-1440.

Ordering Secondary Science Continuum Assessment Instruments and Support Materials. Los Angeles Unified School District: Office of Instruction. Latest Revision.

Putting Critical Thinking to Work. Los Angeles Unified School District: Office of Instruction. Publication No. EC-501. Stock No. 463180.

Reaching Higher Levels of Thought. Los Angeles Unified School District: Office of Instruction. Publication No. X-118. Stock No. 463320.

Safety and Workers Compensation Reference Guide. Los Angeles Unified School District, 1980. Sections 2370-45 through 2370-54.

Science. Los Angeles Unified School District: Office of Instruction. Publication No. SC-769. Stock No. 461278.

Science Materials Center Catalog and Loan Equipment List for Senior High Schools, Order Forms, and Other Information. Annually Revised. Los Angeles Unified School District: Office of Instruction.

Stones and Bones. A laboratory and interdisciplinary program in physical anthropology. Ordering information available from project director. (213) 625-6419 or disseminator (213) 997-2389.

Study Center Activity Cards. Los Angeles Unified School District: Office of Instruction. Publication No. GC-32. Stock No. 463640.

Suggested Terminal Objectives: Science, Junior and Senior High Schools. Examples of instructional objectives, together with samples or pre- and post-test items. 76 pp. Los Angeles Unified School District: Office of Instruction. Publication No. SC-711.

Catalog of Standard Supplies for Elementary, Secondary, and Adult Schools. Latest Revision. Los Angeles Unified School District: Materiel Section.

Teaching the Essential Skills. Los Angeles Unified School District: Office of Instruction. Publication No. GC-82. Stock No. 463818.

Test-Taking Procedures and Techniques for Secondary Schools. Los Angeles Unified School District: Office of Instruction. Publication No. X-116. Stock No. 463897.

The Teaching of Values. Los Angeles Unified School District. Office of Instruction. Publication No. GC-56. Stock No. 463810.

Use Metric! Activities to Help Parents Get the "Feel" of SI Metric Units of Measure. A Teacher's Guide. Los Angeles Unified School District: Office of Instruction. Revision. Publication No. SC-726, 1979. 48 pp.

We Tried It. We Liked It. Los Angeles Unified School District: Office of Instruction. Publication No. GC-77. Stock No. 464415.

## INTRODUCTION TO THE SCIENCE CONTINUUM, GRADES 7-12

### PURPOSES

Science is the discipline which involves the acquiring and organizing of knowledge to explain natural phenomena and to increase their usefulness to humankind. Through the science instructional program in secondary schools, students develop an understanding that science is a body of knowledge comprised of interconnected sets of principles, laws, and theories that explain the known universe and our relationship to it. Students use learning processes to systematically investigate phenomena and acquire and refine information. Outcomes include understanding how human beings use scientific information and discoveries to comprehend and practice the pursuit of objective knowledge as a source of truth.

### COMPONENTS

The Science Continuum encompasses the four competency strands of attitudes, thinking processes, skills, and knowledge. Within each strand, the continuum includes objectives and the kinds of performance necessary for the student to achieve each objective. However, the continuum does not limit the scope of the science curriculum. Teachers should encourage students to progress to the extent of their interests and abilities. In the continuum, certain symbols are used. Items with a solid dot identify the expectancy level for all students. Those items without dots identify levels above those expected for all students. An open circle in the K-6 column indicates that certain items are first introduced to the student in elementary school.

Attitudes Strand. This strand emphasizes the development of values, aspirations, and attitudes which promote the personal involvement of the individual with the environment and society. The attitudes listed relate to what is hoped students will accomplish, individually, through self-motivation, as a result of science instruction. Positive attitudes toward science and learning are prerequisites to effective learning in other strands.

Objectives of the attitudes strand include the ability of the learner to: internalize scientific attitudes; establish the personal and social relevance of what has been learned about science, scientists, and society; and enjoy and appreciate science.

Thinking Processes Strand. The goal is to help the student develop and apply rational and creative thinking processes. As defined here, these processes refer to the cognitive techniques involved in scientific inquiry as well as those basic to all rational thinking. Such processes as observing, measuring, comparing, and classifying lead to more sophisticated processes, such as inferring, generalizing, and theorizing.

Skills Strand. The goal is to help the student develop and use fundamental skills in the manipulation of materials and equipment, in caring for and handling living organisms, and in gathering, organizing, and communicating information relating to science. Various skills are utilized when the student employs thinking processes to develop a conceptual understanding of the natural environment and collects information through observation, manipulation of materials and apparatus, reading, listening, use of measuring instruments, and handling of living organisms. He or she employs linguistic, mathematical, graphical, and tabular skills in recording and organizing information.

A major goal of science education is the provision of opportunities for learners to develop and use these manipulative and communicative skills. Many areas of the curriculum relate closely to the skills that are critical to science education. Reading, writing, speaking, and listening skills are all basic to the communication needs of science students. Many of the skills described in the section are essential in a broad spectrum of occupations. For example, people in almost every occupation must be able to obtain, record, process, interpret, and report information and to communicate ideas in a clear, convincing manner. The skills goal is not only critical to science education, but it is also important in the development of competencies necessary for effective citizenship.

Knowledge Strand. The goal is to assist the student in developing knowledge of processes, facts, principles, generalizations, and applications -- the products of science -- and to encourage their use in the interpretation of the natural environment. Acquisition of organized knowledge is a long-range goal of science and science education. Through an understanding of contributing facts, unifying principles, and relevant processes, organized knowledge gradually takes on meaning for the learner. He or she will acquire some knowledge as a by-product of instruction intended to develop attitudes, skills, and thinking processes and will acquire other knowledge as a deliberate result of instruction. At all levels, the knowledge goal must be in balance with and consistent with the other goals of science education.

Four types of knowledge can be highlighted as components of this goal: (1) knowledge that enables the learner to communicate the thinking processes and skills of science; (2) knowledge that constitutes broad generalizations which interrelate the many facts, concepts, and principles of all the sciences; (3) knowledge of how science and technology affect society; and (4) knowledge that constitutes the content, basic concepts, and structure of the major disciplines in science.

### IMPLEMENTATION

Through the in-service process, the teacher should become fully cognizant of the Science Continuum, its rationale, and its possible use. The goals and objectives of the continuum are basic to all science courses and are consistent with the provisions of AB 65 and the forthcoming State Science Framework. District-developed pretests and posttests are planned to assist teachers in evaluating each student's level of achievement in relation to the Science Continuum. The results of pretests should be used in planning instruction to meet more effectively group and individual needs. In addition, the teacher should formulate a variety of ways to assist the student needing additional instruction.

Approaches to instruction may include:

Development of learning centers
Assignment to independent study projects
Improvement of classroom management



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Use of additional instructional resources
Introduction of changes in organization within the science department; e.g., use of minicourses, team teaching
Expansion of tutoring program
Improvement of counseling

Pretests and other tests prepared by the teacher should:

Be used to evaluate continuum goals and learner performance objectives.
Consist only of items based on performance objectives expected of all students.
Assess understanding of science concepts rather than reading ability.
Avoid items which are of a controversial nature with respect to individual religious or political beliefs.
Relate to life situations common to individuals in all cultural groups.
Involve problem statements with supporting data, as expressed in graphs, tables, pictorials, and other illustrations.
Whereever possible, relate items from skills, thinking processes, and attitudes objectives to knowledge objectives.

Test items related to attitudes should give the learner an opportunity to utilize knowledge applicable to the appropriate scientific attitude. This may or may not reflect the learner's personal attitude.

Test items related to thinking processes should be based on hypothetical problem-solving experiments and include questions that assess the student's understanding of scientific methods.

Test items related to skills should include questions about science apparatus, rules of safety, materials, and equipment common to both biological and physical sciences. Illustrations should be included.



SCIENCE CONTINUUM
GRADES 7-12

SYMBOLS
- ---- = Awareness/Exposure
- 0 = Introduction/Development
- ● = Assessment/Evaluation
- —— = Maintenance/Reinforcement

1.0.0 ATTITUDES

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 1.1.0 | SHOWS CURIOSITY ABOUT OBJECTS AND EVENTS. | | | | | | | |
| 1.1.1 | Shows willingness to examine and organize objects and events in the environment. | 0 | — | ● | — | ● | | |
| 1.2.0 | RECOGNIZES AND REPORTS EVIDENCE OF ORDER AND SYMMETRY IN THE ENVIRONMENT. | | | | | | | |
| 1.2.1 | Relates classification to everyday life situations. | 0 | — | ● | — | ● | | |
| 1.3.0 | APPRECIATES AND RESPECTS ALL LIVING ORGANISMS, INCLUDING SELF AND HIS/HER RELATIONSHIP TO THE ENVIRONMENT. | | | | | | | |
| 1.3.1 | Accepts responsibility for the care of living organisms in natural and artificial environments. | 0 | — | ● | — | ● | | |
| 1.3.2 | Appreciates the interdependence of living organisms in the natural environment and the implications for continued survival. | 0 | — | ● | — | ● | | |
| 1.4.0 | TAKES AN ACTIVE ROLE IN SOLVING SOCIAL PROBLEMS RELATED TO SCIENCE AND TECHNOLOGY | | | | | | | |
| 1.4.1 | Practices conservation in use of food, energy, and materials. | 0 | — | ● | — | ● | | |
| 1.4.2 | Develops and expresses an opinion on a social issue. | 0 | — | — | — | — | — | — |
| 1.4.3 | Seeks to influence the views and behaviors of others with respect to social issues related to science and technology. | | | | | — | — | — |
| 1.5.0 | WEIGHS ALTERNATIVE SCIENTIFIC, ECONOMIC, PSYCHOLOGICAL, OR SOCIAL FACTORS WHEN CONSIDERING POSSIBLE SOLUTIONS TO SOME PROBLEMS. | | | | | | | |
| 1.5.1 | Recognizes the alternative factors to be considered when examining possible solutions. | 0 | — | ● | — | ● | | |
| 1.5.2 | Examines a variety of alternative viewpoints on scientific issues to form opinions about them. | | | — | — | — | — | — |





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ATTITUDES (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 1.6.0 | ORGANIZES AND REPORTS THE RESULTS OF SCIENTIFIC INVESTIGATIONS IN AN HONEST AND OBJECTIVE MANNER. | | | | | | | |
| 1.6.1 | Understands the need to log only those data he/she has actually gathered. | ○ | — | ● | — | ● | | |
| 1.6.2 | Forms opinions only after seeking a variety of data and ideas. | | | ● | — | ● | | |
| 1.6.3 | Assumes responsibility for reporting results in an honest and objective manner. | ○ | — | ● | — | ● | | |
| 1.7.0 | HAS A CRITICAL, QUESTIONING ATTITUDE TOWARD INFERENCES, HYPOTHESES, AND THEORIES. | | | | | | | |
| 1.7.1 | Shows an interest in responding to contradictions between data and theory. | | | | | | | |
| 1.8.0 | APPLIES RATIONAL AND CREATIVE THINKING PROCESSES WHEN TRYING TO FIND RELATIONSHIPS AMONG SEEMINGLY UNRELATED PHENOMENA AND WHEN SEEKING SOLUTIONS TO PROBLEMS. | | | | | | | |
| 1.8.1 | Attempts spontaneously to describe an object or event that has attracted his/her attention. | ○ | — | ● | — | ● | | |
| 1.8.2 | Applies science problem-solving techniques in everyday life situations. | ○ | — | ● | — | ● | | |
| 1.9.0 | RECOGNIZES THE VALUES OF SCIENCE AS A HUMAN ENDEAVOR REPRESENTING ALL RACIAL, ETHNIC, AND CULTURAL BACKGROUNDS. | | | | | | | |
| 1.9.1 | Chooses to gather information and report on the contributions of all cultures to the scientific world. | ○ | — | ● | — | ● | | |
| 1.9.2 | Acknowledges that race, sex, or nationality should not constitute a barrier to scientific study. | ○ | — | ● | — | ● | | |
| 1.9.3 | Values the scientific contributions of human beings from varying cultural backgrounds. | ○ | — | ● | — | ● | | |





ATTITUDES (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 1.10.0 | CONSIDERS SCIENCE RELATED CAREERS AND MAKES REALISTIC DECISIONS ABOUT PREPARING FOR SUCH CAREERS, TAKING INTO ACCOUNT ABILITIES, INTERESTS, AND PREPARATION REQUIRED. | | | | | | | |
| 1.10.1 | Values the abilities, interests, and preparation required for a science-related career. | | | ● | — | ● | | |
| 1.10.2 | Assumes responsibility for making a realistic decision about the pursuit of a science-related career. | | | | | | | |

2.0.0 THINKING PROCESSES

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 2.1.0 | DEVELOPS ABILITY TO GENERATE DATA BY OBSERVING, RECALLING, RECOGNIZING, IDENTIFYING, AND MEASURING. | | | | | | | |
| 2.1.1 | Examines objects carefully, using a combination of senses to collect and process data; derives meaning from the observation; recognizes the need to use simple instruments to aid the senses in collecting data. | ○ | — | ● | — | ● | | |
| 2.1.2 | Determines the need to repeat observations as a means of improving reliability. | ○ | — | ● | — | ● | | |
| 2.1.3 | Uses measurement procedures to improve accuracy of observations. | ○ | — | ● | — | ● | | |
| 2.1.4 | Identifies changes in properties and rates of change. | ○ | — | — | — | — | | |
| 2.2.0 | DEVELOPS ABILITY TO ORGANIZE DATA BY COMPARING, CLASSIFYING, RELATING, AND ORDERING. | | | | | | | |
| 2.2.1 | Perceives similarities and differences in a set of objects; separates a set into groups according to a single characteristic. | ○ | — | ● | — | ● | | |
| 2.2.2 | Develops arbitrary classification systems wherein objects can be put into mutually exclusive categories; uses quantitative measurements as criteria for grouping. | | | — | — | — | | |

THINKING PROCESSES (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 2.3.0 | DEVELOPS ABILITY TO APPLY AND EVALUATE DATA AND GENERATE THEORIES BY HYPOTHESIZING, PREDICTING, INFERRING, GENERALIZING, THEORIZING, EXPLAINING, JUSTIFYING, JUDGING, AND INTERPRETING. | | | | | | | |
| 2.3.1 | Examines environmental issues, pointing out contradictions and discrepancies in the positions of various groups. | | | | | | | |
| 2.3.2 | Gathers own data to form own point of view, satisfying any former contradictions. | o | | | | | | |
| 2.3.3 | Recognizes contradictions and unusual events. | | | | | | | |
| 2.3.4 | Designs experiments to produce specific data to support or refute a hypothesis. | | | | | | | |
| 2.4.0 | PARTICIPATES IN SCIENTIFIC INQUIRY AT THE APPROPRIATE LEVEL. | | | | | | | |
| 2.4.1 | Defines a problem related to an unusual event. | | | | | | | |
| 2.4.2 | Identifies data needed to test a hypothesis; designs an experiment to generate the data; records and organizes data; and evaluates the hypothesis in light of new data. | | | | | | | |

3.0.0 SKILLS

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 3.1.0 | ASSEMBLES AND USES LABORATORY APPARATUS, TOOLS, AND MATERIALS IN A SKILLFUL MANNER, GIVING DUE ATTENTION TO SAFETY MEASURES. | | | | | | | |
| 3.1.1 | Manipulates simple materials, apparatus, and equipment in a safe manner. | o | | • | | • | | |
| 3.1.2 | Demonstrates growth in the ability to manipulate more complex science materials and equipment. | | | o | | • | | |
| 3.1.3 | Acquires and assembles appropriate science apparatus, materials, and equipment in order to obtain designated data. | | | | | | | |





SKILLS (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 3.2.0 | DEMONSTRATES PROPER TECHNIQUES FOR HANDLING AND CARING FOR LIVING ORGANISMS. | | | | | | | |
| 3.2.1 | Handles plants and animals carefully, following suggested procedures. | o | | • | | • | | |
| 3.2.2 | Provides an environment for plant and animal life that is conducive to the support of normal life functions. | o | | • | | • | | |
| 3.3.0 | GATHERS THE INFORMATION NEEDED FOR DEVELOPING OR TESTING INFERENCES AND HYPOTHESES BY MAKING PURPOSEFUL, OBJECTIVE OBSERVATIONS OF THINGS AND EVENTS. | | | | | | | |
| 3.3.1 | Makes purposeful, objective observations. | o | | • | | • | | |
| 3.3.2 | Determines the timing of a series of events. | | | | | | | |
| 3.4.0 | GATHERS NEEDED INFORMATION, WHICH HAS BEEN GENERATED BY OTHERS, FROM A VARIETY OF SOURCES APPROPRIATE TO HIS/HER ABILITY LEVEL. | | | | | | | |
| 3.4.1 | Listens to the ideas of others. | o | | • | | • | | |
| 3.4.2 | Gathers information from science textbooks, reference materials, science films, and television. | o | | • | | • | | |
| 3.4.3 | Finds sources of information needed to solve a problem related to a specific topic. | o | | • | | • | | |
| 3.5.0 | RECORDS OBSERVATIONS ACCURATELY AND ORGANIZES DATA AND IDEAS IN WAYS THAT IMPROVE THEIR USEFULNESS. | | | | | | | |
| 3.5.1 | Orally describes a series of events that have taken place. | o | | • | | • | | |
| 3.5.2 | Tabulates information and uses tables. | | | | | | | |
| 3.5.3 | Interprets graphs and displays data graphically. | o | | | | | | |
| 3.6.0 | COMMUNICATES WITH OTHERS IN A MANNER THAT IS CONSISTENT WITH KNOWLEDGE. | | | | | | | |
| 3.6.1 | In group settings, orally describes observations and answers questions. | o | | • | | • | | |
| 3.6.2 | Explains, either orally or in writing, the methods and procedures involved in carrying out an investigation. | o | | | | | | |

SKILLS (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 3.7.0 | USES THE METRIC SYSTEM EFFECTIVELY. | | | | | | | |
| 3.7.1 | Counts, uses numbers, and balances objects on an equal-arm balance scale. | 0 | | ● | | ● | | |
| 3.7.2 | Measures linear distances, using a metric ruler. | 0 | | ● | | ● | | |
| 3.7.3 | Uses a balance to determine the mass of objects. | 0 | | | | ● | | |
| 3.7.4 | Measures volume of liquids in a graduated cylinder marked in metric units. | | | | | | | |
| 3.8.0 | APPLIES APPROPRIATE MATHEMATICAL CONCEPTS AND SKILLS IN INTERPRETING DATA AND IN SOLVING PROBLEMS. | | | | | | | |
| 3.8.1 | Calculates rates from data. | | | | | | | |
| 3.8.2 | Finds the mean and median of a series of measurements. | | | | | | | |
| 3.8.3 | Utilizes exponential notation to express very large and very small numbers. | | | | | | | |
| 3.8.4 | Determines degree of precision of measurement and quantities derived from measurements. | | | | | | | |
| 3.8.5 | Uses calculators and/computers to advantage in manipulating data and solving problems. | | | | | | | |

4.0.0 KNOWLEDGE

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 4.1.0 | DEMONSTRATES KNOWLEDGE OF THE PROCESSES OF SCIENTIFIC INQUIRY. | | | | | | | |
| 4.1.1 | Distinguishes between trial and error and controlled investigations. | 0 | | ● | | ● | | |
| 4.1.2 | Matches names of various processes and products of scientific inquiry with examples. | | | | | | | |
| 4.1.3 | Evaluates procedures in the inquiry process that have been omitted or inadequately performed. | | | | | | | |





KNOWLEDGE (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 4.2.0 | DEMONSTRATES UNDERSTANDING OF BASIC GENERALIZATIONS, RELATIONSHIPS, AND PRINCIPLES. | | | | | | | |
| 4.2.1 | Identifies simple cause-effect relationships. | 0 | | ● | | ● | | |
| 4.2.2 | Uses a cause-effect relationship to make a prediction. | 0 | | | | | | |
| 4.2.3 | Recognizes that atoms are composed of electrons, protons, neutrons, and other particles. | 0 | | | | ● | | |
| 4.2.4 | Recognizes that electrons are negatively charged and protons are positively charged. | | | | | ● | | |
| 4.2.5 | Illustrates that the number of atomic particles varies with each element. | | | | | ● | | |
| 4.2.6 | Recognizes that matter is composed of particles which are in constant motion. | | | | | ● | | |
| 4.2.7 | Describes interaction and reorganization of units of matter and their association with changes of energy. | | | | | | | |
| 4.2.8 | Recognizes the uses of fuels. | 0 | | ● | | ● | | |
| 4.2.9 | Identifies examples of kinetic and potential energy. | | | | | ● | | |
| 4.2.10 | Identifies pairs of objects having similar properties. | 0 | | ● | | ● | | |
| 4.2.11 | Describes systems of classification used to sort a group of miscellaneous objects. | 0 | | ● | | ● | | |
| 4.2.12 | Recognizes that classification systems are developed by humans for the use of humans and are one way of helping to understand the basic organization and pattern of nature. | | | ● | | ● | | |
| 4.3.0 | DEMONSTRATES KNOWLEDGE OF RELATIONSHIPS BETWEEN SCIENCE AND SOCIETY. | | | | | | | |
| 4.3.1 | Gives examples of ways in which the use of scientific knowledge has affected society. | 0 | | ● | | ● | | |
| 4.3.2 | Describes aspects of a society that tend to encourage or inhibit the advancement of science. | | | | | | | |
| 4.3.3 | Identifies types of data valuable in planning environmental changes. | | | | | | | |

KNOWLEDGE (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 4.4.0 | DEMONSTRATES KNOWLEDGE OF SCIENCE-RELATED CAREER OPPORTUNITIES AND THE PREPARATION NEEDED. | | | | | | | |
| 4.4.1 | Compares the work performed by persons in science occupations. | O | | | | | | |
| 4.4.2 | Identifies ways in which careers are science related. | O | | | | | | |
| 4.5.0 | DEMONSTRATES KNOWLEDGE OF CONTRIBUTIONS TO SCIENCE AND TECHNOLOGY MADE BY MEN AND WOMEN OF VARIOUS RACES AND NATIONALITIES. | | | | | | | |
| 4.5.1 | Matches significant discoveries to persons responsible. | O | | | | | | |
| 4.6.0 | DEMONSTRATES KNOWLEDGE OF THE RELATIONSHIPS OF SCIENCE TO OTHER AREAS OF HUMAN ENDEAVOR. | | | | | | | |
| 4.6.1 | Identifies how modern techniques of determining the age of specimens contribute to knowledge of earlier civilizations. | | | | | | | |
| 4.7.0 | DEMONSTRATES KNOWLEDGE OF WAYS IN WHICH ATTITUDES, THINKING PROCESSES, AND SKILLS CAN BE RELATED FOR USE IN PERSONAL DECISION-MAKING. | | | | | | | |
| 4.7.1 | Given a list of foods, identifies items that would constitute a nutritious, balanced meal. | O | | ● | | ● | | |
| 4.7.2 | Given manufacturers' literature and consumer research data, selects an object on the basis of comparison of various factors. | | | | | ● | | |
| 4.7.3 | Uses data from scientific investigations in presenting a position on a political issue. | | | | | | | |
| 4.8.0 | DEMONSTRATES GENERAL KNOWLEDGE OF SCIENCE. | | | | | | | |
| 4.8.1 | Recognizes that a cell is the basic unit of structure and function of a living organism. | O | | ● | | ● | | |
| 4.8.2 | Recognizes that all living organisms have the same life processes. | O | | ● | | ● | | |
| 4.8.3 | Demonstrates a basic knowledge of the structures and functions of the human organism. | O | | ● | | ● | | |
| 4.8.4 | Understands and describes living organisms that grow and develop in different environments. | O | | ● | | ● | | |
| 4.8.5 | Recognizes that the sun is the source of energy for green plants and is basic to the growth and maintenance of living organisms. | O | | ● | | ● | | |







KNOWLEDGE (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 4.8.6 | Recognizes the importance of energy levels as related to ecosystems. | | | | | | | |
| 4.8.7 | Recognizes that living organisms utilize matter and return it to the environment. | O | | | | | | |
| 4.8.8 | Describes examples of humankind's dependence on and interference with natural ecosystems. | O | | ● | | ● | | |
| 4.8.9 | Recognizes that a living organism is a product of its heredity and environment. | O | | ● | | ● | | |
| 4.8.10 | Recognizes that all forms of life are composed of the same elements in different DNA blueprints. | | | | | | | |
| 4.8.11 | Understands relationships of structure and function of living organisms to their environment. | | | | | ● | | |
| 4.8.12 | Recognizes that living organisms have changed over the ages and that some species are now extinct. | O | | ● | | ● | | |
| 4.8.13 | Recognizes that the motion and path of celestial bodies are predictable. | O | | ● | | ● | | |
| 4.8.14 | Describes the regular movements of the earth and moon. | O | | ● | | ● | | |
| 4.8.15 | Demonstrates an appreciation and understanding of time/space relationships. | O | | | | | | |
| 4.8.16 | Demonstrates knowledge of basic differences between planets, stars, the solar system, the Milky Way Galaxy, and the known universe. | O | | ● | | ● | | |
| 4.8.17 | Cites some of the accomplishments in humankind's exploration of space. | O | | ● | | ● | | |
| 4.8.18 | Demonstrates knowledge of the effects of moon and sun on ocean tides. | O | | | | | | |
| 4.8.19 | Recognizes that matter exists as solids, liquids, and gases. | O | | ● | | ● | | |
| 4.8.20 | Demonstrates that in chemical or physical changes the total amount of matter remains unchanged. | O | | ● | | ● | | |
| 4.8.21 | Recognizes that in nuclear reactions a loss of matter is a gain in energy, the sum of matter and energy remains constant. | | | ● | | ● | | |

KNOWLEDGE (CONT.)

| | | K-6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|
| 4.8.22 | Recognizes that there are continuous changes on earth. | 0 | — | • | — | • | | |
| 4.8.23 | Recognizes that rocks contain one or more kinds of minerals. | 0 | — | — | — | — | | |
| 4.8.24 | Recognizes the three major types of rocks that make up the earth. | - - | - - | - | | | | |
| 4.8.25 | Recognizes the value of using renewable energy sources instead of non-renewable sources. | 0 | — | • | — | • | | |
| 4.8.26 | Identifies major factors that cause weather changes and patterns. | - - | - - | - | | | | |
| 4.8.27 | Identifies the effect of weather on the local environment. | 0 | — | • | — | • | | |
| 4.8.28 | Identifies the ocean as a major influence on weather. | 0 | — | • | — | • | | |
| 4.8.29 | Recognizes simple machines and their functions. | 0 | — | — | — | — | | |
| 4.8.30 | Understands the definitions and interrelationships of force, work, and energy. | | | — | — | — | — | — |